

Solar power plant 618.8 kWp monitoring correction on the Fusion application

Sindak Hutaauruk¹, Pandapotan Siagian², Reinhard A. Sitinjak¹

¹Department of Electrical Engineering, Faculty of Engineering, Universitas HKBP Nommensen, Medan, Indonesia

²Department of Computer, Faculty of Electrical Engineering, Institut Teknologi DEL, North Sumatera, Indonesia

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ABSTRACT

Monitoring of energy produced by the solar power plant (SPP) with a capacity of 618.8 kWp at HKBP Nommensen University in Medan is carried out using the FusionSolar application. This SPP energy management application includes displaying yield, energy consumption, energy exports, and SPP energy imports. The amount of energy displayed using the FusionSolar application is compared with the amount of energy resulting from manual calculations based on power data displayed on the alternating current (AC) combiner panel from 3-phase inverters. This comparison was carried out over seven days of measurements. It produced an average difference of 5.779%, with a correction value of 0.942, so the energy reading resulting from the FusionSolar application must be multiplied by this correction value.

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Corresponding Author:

Sindak Hutaauruk

Department of Electrical Engineering, Faculty of Engineering, Universitas HKBP Nommensen

UHN Campus, St. Sutomo, Medan 20234, Indonesia

Email: sindak@uhn.ac.id

1. INTRODUCTION

The solar power plant or SPP used at HKBP Nommensen University produces 618.8 kWp installed on rooftop of the building as seen in Figure 1 [1]-[5]. Monitoring of the power produced by the SPP is displayed using the FusionSolar application [6]-[8], which displays power yield, power consumption, power export, and power imports. Yield is the amount of energy produced by SPP in 1 day, power consumption is the amount of energy used by the load in 1 day, power export is the amount of energy transferred to the state electricity company (PLN) (excess energy produced by SPP), and import power is the amount of energy taken from PLN to meet the power shortage produced by SPP. Figure 2 illustrates power export to PLN where the SPP produces 800 kWp of power while the load power is 600 kWp, so excess power of 200 kWp is exported to PLN [9]-[13]. Figure 3 illustrates power imports from PLN, where the SPP produces 600 kWp while the load power is 800 kWp. To meet the load power, power is imported from PLN to the load [14], [15].

Exporting and importing electric power is carried out automatically via the automatic transfer switch (ATS). All power exported and imported from SPP to PLN or vice versa is displayed on the kWh meter so that SPP and PLN know the power exported and imported, respectively. The recording of the power produced by the SPP is displayed using the solar Fusion application. The power recording in the solar Fusion application must be compared with the recording carried out manually to obtain a correction factor for the recording carried out with the solar Fusion application.

Power monitoring can be done using internet of thing or IoT via a microcontroller [12], [16]-[22]. This research uses the FusionSolar application, which can be seen on the panel at the power plant or Android via internet of things or IoT. This application displays the results of power, power consumption, power export,

and power import, which can be seen within one day, one month, or a certain period as in Figure 4. The power displayed in this monitoring must be corrected by directly measuring the three inverters used [23], [24]. This correction value will be obtained after comparing the energy measurement results with the energy displayed in monitoring using the FusionSolar application [25].



Figure 1. The solar panels on the SPP are used on the rooftop of the campus building

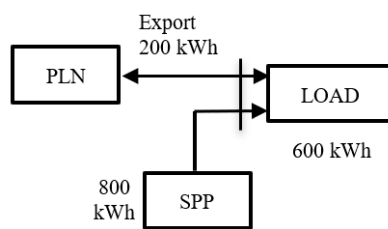


Figure 2. Power export

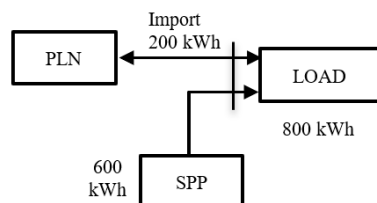


Figure 3. Power import



Figure 4. Power display with the FusionSolar application

2. METHOD

This research method was carried out by comparing monitoring results using the FusionSolar application with measurements carried out manually by reading data from voltage and current measurements from the three inverters on the combiner panel as displayed in Figure 5. This measurement was carried out for seven days, starting on 15 August 2023 and ending on 25 August 2023, with an energy measurement flow diagram as in Figure 6. The R, S, and T power from the three inverters on the AC combiner panel is read every 30 minutes from 08.00 Western Indonesia Time (WIB), reading 19 times until 17.00 WIB for seven days. Power readings for 19 times each day are averaged and multiplied by 12 to obtain the energy produced for one day (12 hours) [23], [24]. The energy calculation data for the three inverters during the seven-day measurement period was compared with the energy data obtained through the FusionSolar application. The correction value for the data read using the FusionSolar application was obtained. The flowchart for obtaining this correction value is shown in Figure 7.

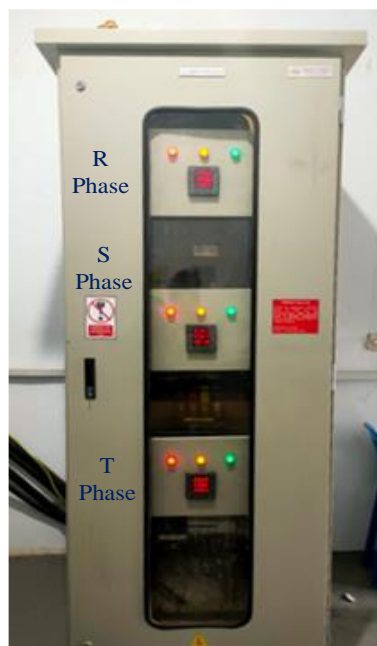


Figure 5. Panel AC combiner

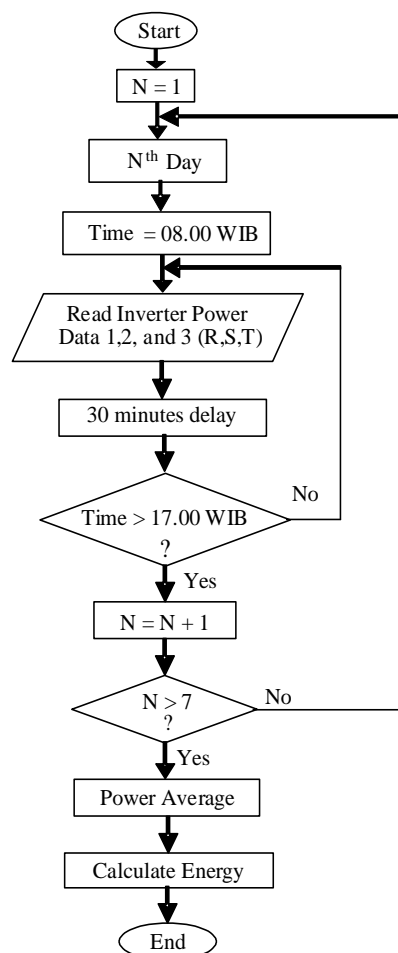


Figure 6. Energy measurement flowchart

The amount of power reading on the AC combiner panel converted into energy daily is compared with the energy read by the FusionSolar application. So, every day, a correction value is obtained for the energy reading from the FusionSolar application. If the energy reading in the FusionSolar application is 95 kWh and the energy reading from the manual reading on the AC combiner panel is 92 kWh, then the correction value (K) is $K = \frac{92}{95} = 0.968$.

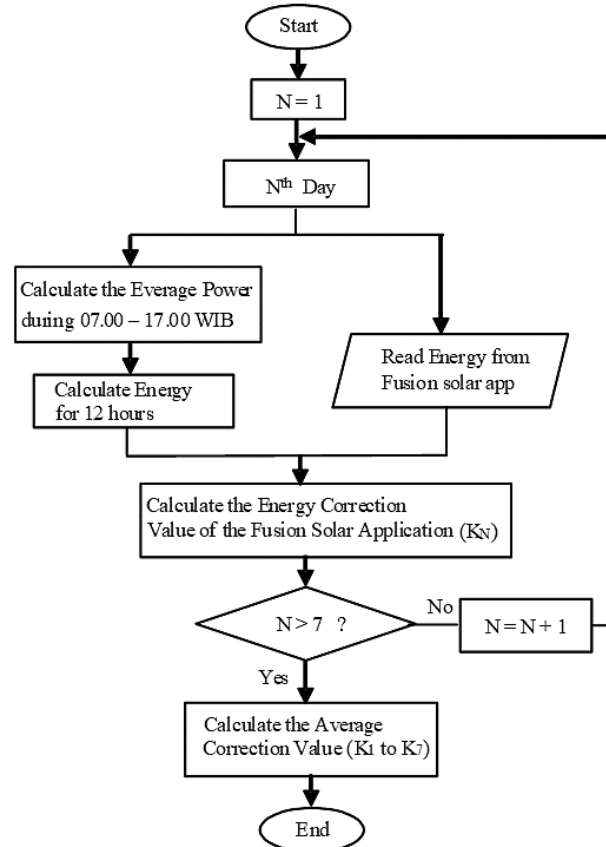


Figure 7. The flowchart determines the correction value

3. RESULTS AND DISCUSSION

Readings were taken of the energy displayed on the FusionSolar application for seven days. Likewise, readings were manually taken on the same day for seven days on the AC combiner panel in the powerhouse. The energy readings from the FusionSolar application must be the same as the power reading times for the three inverters on the AC combiner panel, namely on 15, 16, 18, 19, 21, 22, and 25 August 2023. The results of the energy readings from monitoring the FusionSolar application are shown in Table 1 and Figure 8.

Table 1. Results of power readings on monitoring FusionSolar

Date	Yield (kWh)	Self-consumption (kWh)	Export (kWh)	Import (kWh)
15/08/2023	2,560	1,480	1,090	0.02
16/08/2023	2,160	1,230	929	0.01
18/08/2023	1,760	1,010	753	0.00
19/08/2023	2,100	1,210	887	0.01
21/08/2023	1,720	1,000	719	0.02
22/08/2023	1,500	867	630	0.01
25/08/2023	2,260	1,310	951	0.02
Total	14,060	8,107	5,959	0.09
Everage	2,009	1,158	851	0.01

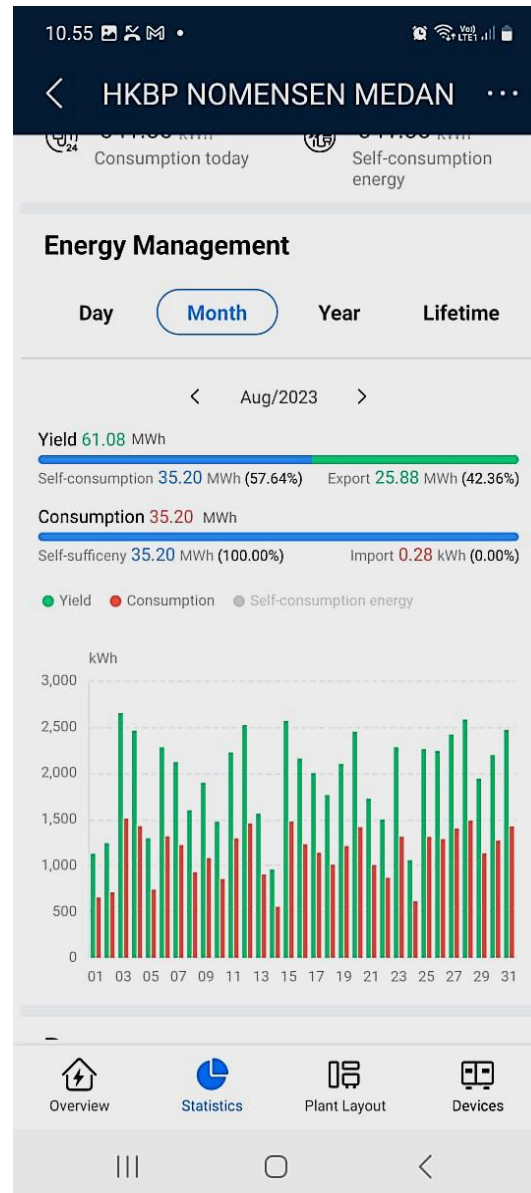


Figure 8. Energy management display with the FusionSolar application in August

To determine whether the SPP is working normally or not, apart from monitoring the FusionSolar application, it is also necessary to take power readings at the powerhouse for seven days to find the amount of power produced from the inverter and an estimate of the amount of energy produced, where the method for determining the percentage of the amount of energy resulting from manual readings to the energy resulting from readings from the FusionSolar application is (1).

$$\frac{\text{Energy results from manual reading}}{\text{Energy on Application monitoring}} \times 100\% \quad (1)$$

Manual power measurements were carried out for seven days, starting from 07.00 WIB to 17.00 WIB, with the results shown in Table 2. By dividing the energy from manual readings by the energy from readings using the FusionSolar application. The average difference between manual energy measurements and measurements using the FusionSolar application for seven days of measurement was 5.779%, so the average correction value obtained for seven days was 0.942, as in Table 3.

A comparison of the amount of energy obtained based on readings on the AC combiner panel and the FusionSolar application is shown in Figure 9. The energy obtained based on manual measurements is, on average, 5.779% smaller than the energy measurement resulting from the FusionSolar application. Improvements were made by entering a correction value of 0.942, as shown in Figure 10.

Table 2. Results of energy readings on the AC combiner for seven days

No.	Date	Daya (KW)									Total (kW)	Energy (kWh)
		Inverter 1			Inverter 2			Inverter 3				
		R	S	T	R	S	T	R	S	T		
1	15/08/2023	18	18	18	20	20	20	28	28	28	198	2,376
2	16/08/2023	16	16	16	16	16	16	24	24	24	168	2,016
3	18/08/2023	13	13	13	13	13	13	19	19	19	135	1,620
4	19/08/2023	15	15	15	15	15	15	25	25	25	165	1,980
5	21/08/2023	13	13	13	13	13	13	20	20	20	138	1,656
6	22/08/2023	12	12	12	12	12	12	17	17	17	123	1,476
7	25/08/2023	17	17	17	17	17	17	24	24	24	174	2,088
Everage		15	15	15	15	15	15	22	22	22	157.29	1,887

Table 3. Fusion reading energy correction value

Date	Energy (kWh)		Difference %	Correction value
	Fusion	Manual		
15/08/2023	2,560	2,376	7.19	0.928
16/08/2023	2,160	2,016	6.67	0.933
18/08/2023	1,760	1,620	7.95	0.920
19/08/2023	2,100	1,980	5.71	0.943
21/08/2023	1,720	1,656	3.72	0.963
22/08/2023	1,500	1,476	1.60	0.984
25/08/2023	2,260	2,088	7.61	0.924
Everage			5.779	0.942

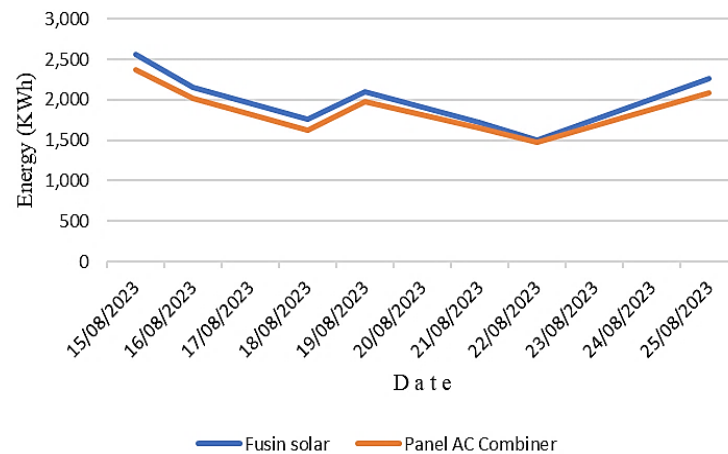


Figure 9. Chart comparison of Fusion and manual energy measurements

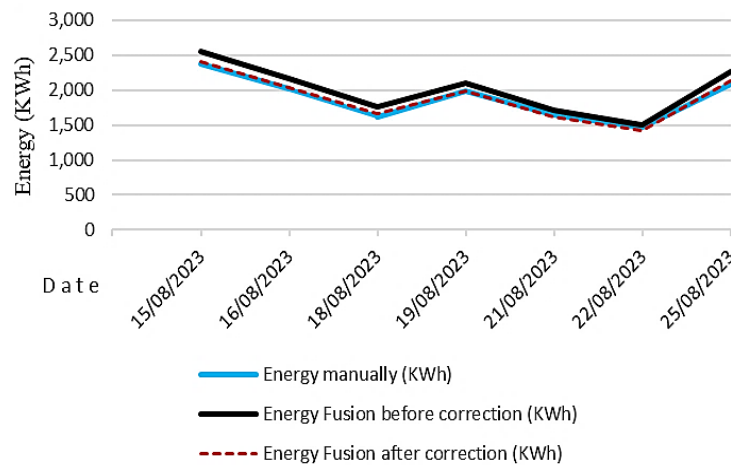


Figure 10. Graph of fusion measurement energy correction results

4. CONCLUSION

The research results show that corrections are needed to improve electrical energy measurements with the FusionSolar application at HKBP Nommensen University in Medan with a correction value of 0.942 so that it is the same as measurements made manually via readings on the AC combiner panel. The amount of electrical energy produced by SPP as measured using the FusionSolar application is 5.779% greater than the actual electrical energy (manual measurement results), so the cost per kWh of FusionSolar measurement results must be reduced by 5.779%, as well as the calculation of the amount of energy exports electricity from the SPP system to PLN and calculation of electrical energy imports from PLN to SPP.

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BIOGRAPHIES OF AUTHORS






Sindak Hutaeruk    is a lecturer in the Department of Electrical Engineering, HKBP Nommensen University, Medan, Indonesia. He completed his undergraduate education in Telecommunications at the Department of Electrical Engineering, Trisakti University, Jakarta, Indonesia. He completed his master's education in Microelectronics in 1991 at the Bandung Institute of Technology, Indonesia, and has completed his undergraduate education as well as doctoral education at the University of North Sumatra, Indonesia. He received awards three times in a row in 1994, 1995, and 1997 as the best researcher in the field of electrical engineering at 11 universities supported by the HEDS- JICA (Higher Education Development Support-Japan International Corporation Agency) project in Indonesia. His expertise is in telecommunications, electronics, and data communications. He serves as head of the Institute for Research and Community Service at HKBP Nommensen University, Medan, Indonesia. He can be contacted at email: sindak@uhn.ac.id.



Pandapotan Siagian    is a lecturer in Department of Computer, Faculty of Electrical Engineering, Institut Teknologi DEL, Laguboti, North Sumatera, Indonesia. His research interests include image processing and biomedical informatic and medical analysis. He has published more than 26 computer science-related journal articles and conference papers. He can be contacted at email: siagian.P@gmail.com.



Reinhard A. Sitinjak    was born on December 19, 2000. Recently, he graduated with a bachelor of electrical engineering at HKBP Nommensen University in 2023. He has participated in research on solar panels that are driven by microcontroller-based auto-tracking. He can be contacted at email: reinhard.ambrosius.s@gmail.com.